

## PATENT ABSTRACTS OF JAPAN

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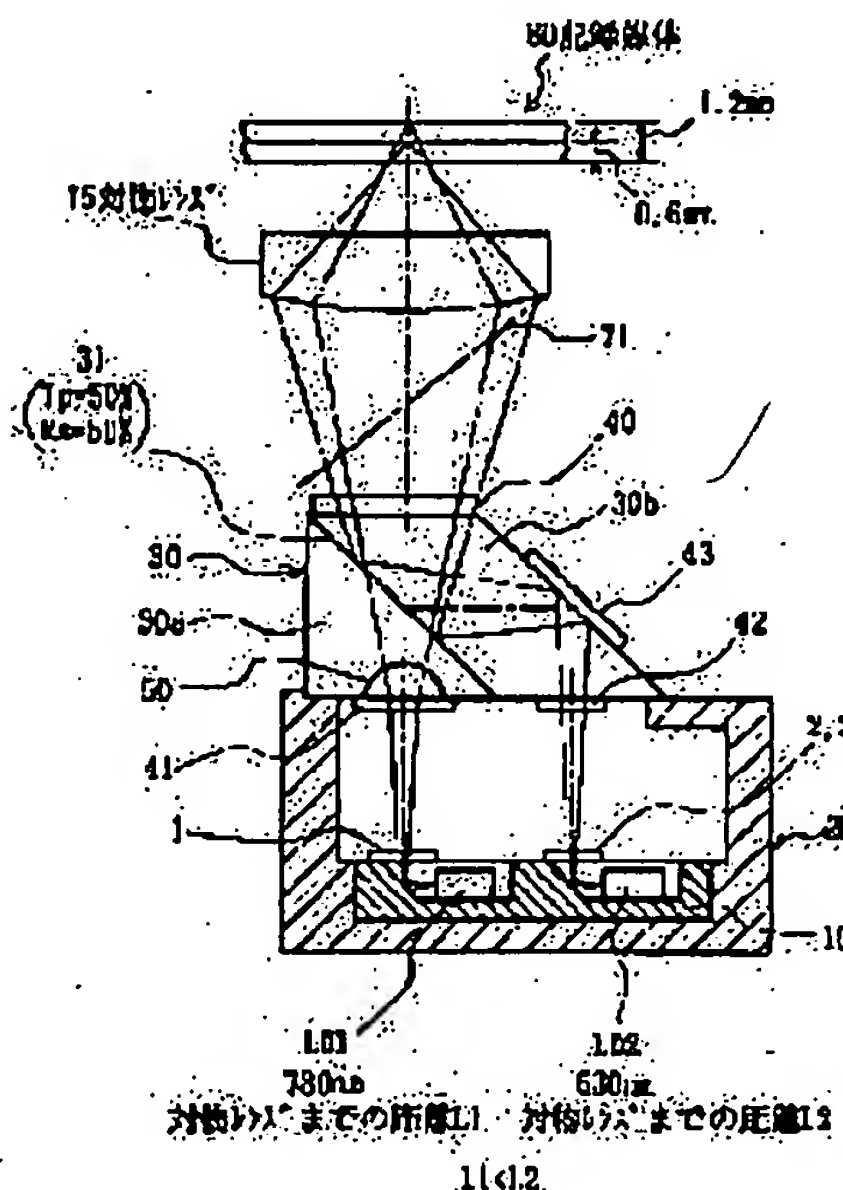
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## (54) OPTICAL UNIT AND OPTICAL PICKUP

## (57)Abstract:

PROBLEM TO BE SOLVED: To obtain an optical unit and optical pickup that reduce the number of component parts and that realize miniaturization advantageously.

SOLUTION: An optical unit has two semiconductor lasers and a photodetector arranged on a semiconductor substrate. Optical beams emitted by the lasers are guided in the same direction by a beam splitter and irradiate a recording medium. An information signals is detected by receiving light reflected from the medium by a photodetector. A diffraction grating is formed on a plane parallel to the semiconductor substrate 10 on which the photodetector is arranged in the beam splitter 30, and the diffraction grating is disposed on a lens 50 for adjusting the divergence angle of the optical beam. Using this structure, it is possible to reduce the occupation area of the optical system, to adjust a numerical aperture on an objective lens with a lens, and to advantageously realize the miniaturization, for example.



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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical unit and optical pickup which can reproduce the record medium with which protection layer thickness, such as CD, CD-R, and DVD, differs especially about the optical pickup equipped with the optical unit and optical unit which can be used for the optical disk unit which records information and is optically reproduced to record media, such as an optical disk, as the light source.

[0002]

[Description of the Prior Art] As optical pickup equipment which can be used for the record medium with which protection layer thickness differs, various proposals are made conventionally. For example, the proposal by JP,10-308031,A (reference 1) is made. This is optical pickup equipment which consists of two beam splitters which have the 1st and 2nd semiconductor laser from which wavelength differs, and a polarization property, a digital videodisc (DVD), a compact disk (CD), and CD-R (mold which can be added) can be reproduced, there is little quantity of light loss and the unpolarized light study system is indicated using the low non-polarized film of angular dependence.

[0003] The configuration is indicated by the 4th page paragraph [0016] of this reference, [0017], etc. in more detail. The optical system is equipped with the 1st semiconductor laser (for CD) and 2nd semiconductor laser (for DVD), leads the light beam by which outgoing radiation was carried out from each laser to a common optical path, and makes it as [ perform / record playback of record media, such as CD, CD-R, and DVD, ]. The common optical path is constituted by each part article arranged on the base, i.e., the 1st and 2nd beam splitters, the mirror, the objective lens, the sensor lens, the photo detector, etc.

[0004]

[Problem(s) to be Solved by the Invention] [1] According to the above-mentioned configuration, the record medium with which protection layer thickness (the depth from a disk inferior surface of tongue to an information recording layer is [ in the case of CD ] 0.6mm in the case of 1.2mm and DVD), such as CD, CD-R, and DVD, differs is reproducible, but Therefore, in order to arrange [ photodetector / which consist of a beam splitter with two polarization properties / prism, semiconductor laser, a photodetector, etc. ], there are many components mark as optical pickup equipment, the number of assemblers is applied, and low cost-ization is a very difficult configuration. Therefore, it is being able to reduce the component part as an optical pickup as this kind of an equipment configuration which can reproduce the record medium with which protection

layer thickness differs, therefore it is desirable that this is realizable, attaining reduction of the number of assemblers and low cost-ization easily again.

[0005] [2] On the other hand, there is a thing of the proposal by JP,10-233033,A (reference 2) as an optical pickup for record playback of DVD, CD, etc. Here, two hologram packages (unit) are used.

[0006] In the optical system, the optical unit for DVD and the optical unit for CD It arranges so that 90 abbreviation may be made with a beam splitter as the starting point, and it results [ from a beam splitter ] in an objective lens (). or pass a collimator lens -- it results in an objective lens -- the optical axis of light -- receiving -- abbreviation -- the optical unit for the DVD in the parallel direction moreover, this optical axis -- receiving - - abbreviation -- the optical unit for the CD is arranged in the perpendicular direction, respectively (the 8th page paragraph [0038] of this reference, the 10th page paragraph [0064], etc.). Each of each optical unit here so that the source of outgoing radiation of light where wavelength differs, a photodetector, a diffraction grating, etc. may be included Although it is arranged as that by which packaging was carried out separately and the playback in the case of being playback in case a record medium is DVD, and CD is made by playback actuation given in 8th page - the 9th page (paragraph [0046]- [0051]) of this reference etc., respectively Since two hologram packages (unit) are used like previous statement, there is a fixed limitation in a miniaturization etc.

[0007] It is it becoming much more advantageous also from from [ when attaining contraction-ization of optical system ], also when offering small pickup here, if share-ization of for example, a hologram unit can be realized appropriately, and therefore more desirable one's also being able to make share-ization of this unit, and being able to realize a miniaturization etc. appropriately.

[0008] This invention will enable it to realize also being able to cancel the technical problem in a Prior art, being able to reduce a component part, and attaining a miniaturization etc. advantageously based on the consideration which carries out a postscript further based on the above considerations.

[0009]

[Means for Solving the Problem] By this invention, the 1st semiconductor laser and this 1st semiconductor laser have the 2nd semiconductor laser which carries out outgoing radiation of the light beam from which wavelength differs. Said 1st semiconductor laser, the 2nd semiconductor laser, and a photodetector are arranged on a substrate. There is a beam splitter which draws the light beam which carries out outgoing radiation from laser in the same direction. It is the optical unit which detects an information signal by irradiating the light beam which penetrated this beam splitter at a record medium, and receiving the reflected light from said record medium with a photodetector. A diffraction grating is formed in a field parallel to the substrate top with which the photodetector has been arranged within a beam splitter, and the optical unit which comes to arrange said diffraction grating on the lens for adjusting the flare angle of a light beam is offered. Therefore, in this invention, components mark increase and it assembles, and it can avoid that a man day starts or low cost-ization becomes difficult, and the occupancy area of optical system can carry out [ \*\*\*\* ]-izing of it, and the numerical aperture (NA) on an objective lens with a lens can be adjusted, and if , it closes realizing a miniaturization etc. advantageously. According to the suitable example, the disadvantage of the above-mentioned Prior art is solved. Two or more semiconductor laser and photodetectors for

example Or semiconductor laser minds submounting. a direct and semi-conductor substrate (Si substrate) -- It is possible to aim at improvement in dependability or endurance because it can do with the structure which unites with the beam splitter which is arranged to metal plate superiors with a photodetector and, by which the diffraction grating was prepared in the close outgoing radiation side of light, for example, reduces the component part as an optical pickup, and seals an optical unit. It becomes possible to offer a small optical pickup further, for example. If this invention is followed, the optical pickup using the above optical units will be obtained again, a lens is arranged between the 1st semiconductor laser and a beam splitter, and an optical pickup equipped with the above-mentioned optical unit characterized by having arranged the 1st semiconductor laser and 2nd semiconductor laser mutually to a collimator lens in the location [ \*\*\*\* ] is offered.

[0010]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 - drawing 5 show one example of this invention. Among these, drawing 1 shows the optical unit according to this invention, and an example of an optical pickup configuration using the optical unit, and drawing 2 - drawing 5 show an applicable diffraction grating and the applicable example of a configuration of a photodetector.

[0011] [Optical unit] Among a Fig., LD1 and LD2 are semiconductor laser which emits the light beam from which wavelength differs mutually, for example, they are semiconductor laser (1st semiconductor laser LD1) with a wavelength of 780nm and semiconductor laser (2nd semiconductor laser LD2) with a wavelength of 630-650nm. In the optical unit according to this example, these semiconductor laser, the photodetector 1 of 5 division arranged near the 1st semiconductor laser, and two photodetectors (two photodetectors (trichotomy and quadrisection)) 2 and 3 that are arranged near the 2nd semiconductor laser and sandwich this 2nd semiconductor laser are arranged on the semiconductor substrate (Si (silicon) substrate) 10.

[0012] What comes whenever the photodetector of 5 division is shown in drawing 2 , and has 5 division photo detector 1PD1 - 1PD5 can be used, and each of other two photodetectors can use what has each division photo detector 2PD1 located in the both sides of a virtual LD light beam point as shown in drawing 3 - 2PD3, and 3PD1 - 3PD4, respectively. The direction of T is a direction parallel to the direction of a truck of a record medium 80 here. It can consider as the configuration by which the semiconductor laser and photodetector of plurality (two pieces) are arranged as mentioned above on a semi-conductor substrate (Si substrate).

[0013] It is unified within the package 20 of a rectangular parallelepiped configuration, and this semi-conductor substrate is sealed by cylindrical or the beam splitter 30 which makes trapezoidal shape which consists of a metal or resin. This beam splitter is what draws the light beam which carries out outgoing radiation from laser in the same direction so that the light beam which penetrated this beam splitter may be irradiated at a record medium. Here Although an optical path is formed so that it may be shown as what consists of prism parts 30a and 30b of the shape of the shape of a triangle, and a parallelogram, the reflected light may be made to receive from a record medium to reflex time with a photodetector and an information signal may be made to detect It can consider as a combining and having-really [ of a unit ]-function of - seal-ized structure



thing like illustration here besides the function of the beam splitter itself [ such ].

[0014] When doing in this way, in the case of the optical unit of this example, a package unit The configuration by semiconductor laser LD1 and LD2, photodetectors 1, 2, and 3, the semi-conductor substrate 10, and the beam splitter 30 (like the after-mentioned) It is related including the configuration arranged on a lens to form two or more diffraction gratings in a field parallel to the semi-conductor substrate top with which the photodetector has been arranged within a beam splitter, and for one diffraction grating adjust the flare angle of a light beam etc. Share-ization makes it effective, and it is based on one package, and is also acting in favor also of having also aimed at reduction and reduction of components mark enough. And as a result of using and utilizing a beam splitter 30 also as an element like the above, adoption of such unification and seal structure acts in favor also of small and contraction-izing, and also becomes becoming advantageous, also although improvement in dependability or endurance etc. is aimed at to coincidence again.

[0015] Furthermore, it is as follows if this beam splitter and its top face, an inferior surface of tongue (close outgoing radiation side), etc. are explained. The beam splitter side (BS side) 31 of the joint of the prism parts 30a and 30b can be made into the mode in which the reflection factor (Rs)50% multilayers of S polarization are formed by permeability (Tp)50% of P polarization for example, by the non-polarization beam splitter, or can be replaced with this and can be made into the mode (for example, refer to the 4th example of a postscript) in which a wavelength selection filter is formed. In the case of a wavelength selection filter, this filter can be used as the filter with which a light beam with a wavelength of 780nm reflects a light beam with a transparency and a wavelength of 630nm - 650nm.

[0016] Although it can consider as the configuration by which the quarter-wave length plate 40 is joined to the top face which carried out the trapezoid configuration, it is unnecessary when a beam splitter does not polarize. Moreover, the hologram component (1st diffraction component) 41 ( drawing 4 ) of quadrisection which consists of a parting line [ \*\*\*\* / parting line / a parting line parallel to the truck (T) of a record medium 80 and / its ], and the grating (2nd diffraction component) 42 which divides into the three diffracted lights the light beam irradiated from the 2nd semiconductor laser, and irradiates a record medium 80 are formed in the inferior surface of tongue parallel to the semi-conductor substrate 10. Thus, in this example, a beam splitter 30 can carry out the basis by which the diffraction grating of plurality (two pieces) was formed in the field parallel to the semi-conductor substrate with which the photodetector has been arranged, and these two or more diffraction gratings consist of the grating component (Gr) and hologram component (HOE) for three beams. In this way, through package 20 part, what has arranged the above-mentioned semiconductor laser LD1 and LD2 and photodetectors 1, 2, and 3 on the semi-conductor substrate 10 can unite with the beam splitter 30 by which the diffraction grating was prepared in the close outgoing radiation side of light, and can consider as the configuration made into the structure to seal. Furthermore, for example, between the hologram component of quadrisection, and the beam splitter side, the spherical lens 50 is formed. This lens is a lens which the angle of divergence of a light beam is changed and was formed in prism partial 30a here like illustration (although a postscript is also touched further, about this, a silica DORIKARU lens is sufficient). On the other hand, it can consider as the configuration in which the hologram component

(3rd diffraction component) 43 from which the grid pitch of two division as shown in drawing 5 which consists of a parting line parallel to the track (T) of a record medium differs is formed in the slant face (inclination end face of prism partial 30b) of 45 degrees (this does not need to use it).

[0017] Although DVD, CD-R, and CD can be used for a record medium 80 so that the after-mentioned may also be carried out About the photodetector for DVD at the time of playback in case a record medium 80 is DVD, a focus, and tracking detection In performing this in the mode by photo detector 2PD1 - 2PD3 like drawing 3 illustrated above, and 3PD1 - 3PD4 For example, the detection method of a publication etc. can be used for JP,8-22624,A (reference 3) (for example, refer to this reference drawing 15), and these are taken in and referred to here. For example, a servo signal and an information signal can be acquired by specifically using partial 3PD1 - 3PD4 as a photodetector for tracking error signal detection by using a part PD 1 - 2PD3 as the photodetector for focal error signal detection, and calculating the detection output by the diffracted light which carries out incidence to these. Moreover, it is the case where record media 80 are CD-R and CD, and when carrying out in the mode of photo detector 1PD1 like drawing 2 illustrated above - 1PD5, the technique by the detection method of 39th page drawing 3 (b) for example, in the Sharp technical report No. 72 and December (reference 4), 1998 can be used, and this is also taken in by this specification and is referred to. In this case, it is a focal error signal about the object for focal error signal detection :P D2-PD3 (the detection output of PD2:partial 1PD2, PD3: detection output of partial 1PD2) Although it is alike and is carried out more, since the dimension of the longitudinal direction of drawing becomes what is small and ends as it faces obtaining such a photodetection output and the overall arrangement configuration of each partial 1PD1 - 1PD5 also shows drawing 2 , if such a photodetector is adopted, it will become advantageous by dedicating in a package 20.

[0018] In the case of the mode shown in drawing 1 , with the optical pickup configuration using the above optical units, there are the objective lens 75 prepared above the beam splitter 30 and a record medium 80 which records or reproduces information. The configuration which is inserted in a thin case can be used for the reflective mirror 71 shown with the chain line.

[0019] It explains below further including the optical unit of this example of the above configurations thru/or actuation of an optical pickup. About the record medium 80 to apply, as touched also in advance, CD-R from which protection layer thickness differs, and CD and DVD can be used. In this case It is made to respond to whether the record media 80 used are CD-R and CD or it is DVD, while corresponds of the two semiconductor laser LD1 and LD2, and a semiconductor laser side is made to emit light (at this time). the semiconductor laser side of another side is not made to emit light -- it makes as [ make / a light beam / condense on a recording track with an objective lens 75 in a convergence location like illustration, respectively (for it to be used in common -- the same) ].

[0020] Now, supposing it is a time of being playback of DVD whose record medium 80 is 0.6mm of substrate thickness like illustration The with a wavelength of 630nm semiconductor laser side is made to emit light. In a location nearer than the optical spot (1.2mm side) formation location for CD (to record-medium side formed in the shallow depth location from the disk inferior surface of tongue) It is made to make the optical

spot by the light beam with a wavelength of 630nm form. Conversely at the time of playback of CD-R of 1.2mm of substrate thickness, and CD The with a wavelength of 780nm semiconductor laser side is made to emit light, and it is made to make the optical spot by the light beam with a wavelength of 780nm form in a location more distant than the optical spot (0.6mm side) formation location for DVD (to record-medium side formed in the deep depth location from the disk inferior surface of tongue). the theoretic and fundamental actuation as the so-called 2 focal optical pickup which uses two semiconductor laser from which such wavelength differs etc. -- being related -- the above-shown reference 1 -- the part which it is indicated by 5th page - the 6th page (a paragraph [0029], [0030], etc.), and corresponds to it is taken in and referred to here.

[0021] The light beam which carries out a deer, carries out incidence to a beam splitter 30 at the time of each record-medium playback, is drawn in the same direction by the beam splitter side 31, and penetrates this beam splitter The reflected light which will be obtained from a this record medium by irradiating the record medium 80 (DVD or CD-R, CD) which corresponds with the above-mentioned objective lens 75 As a return light, outgoing radiation is again carried out from return and a beam splitter 30 in this order of an objective lens 75 and a beam splitter 30. Although it is led on the semi-conductor substrate 10 at the photodetector side with which it corresponds of the photodetectors 1, 2, and 3 arranged on the surroundings of semiconductor laser and detection of an information signal, a focus, and tracking detection are made like previous statement The spherical lens 50 triangle prism partial 30a of the above-mentioned beam splitter 30 was made to possess here can be operated as what has the following operations about the exposure of the light beam to this record medium in case a record medium 80 is DVD.

[0022] [Spherical lens] The case of CD-R and CD, and in the case of DVD, when it can be made to perform both playback of CD-R and CD, and playback of DVD and the numerical aperture (NA) on an objective lens is seen, numerical aperture differs. In the case of CD-R and CD, the numerical aperture NA1 on an objective lens 75 is 0.45. On the other hand, short wavelength is used, substrate thickness is 0.6mm, and, in the case of DVD which should make an optical spot form in a nearer location, numerical aperture NA2 is 0.6. Then, I will enable it to adjust the numerical aperture on an objective lens by arranging a spherical lens 50 into an optical path like illustration in order to realize this. That is, numerical aperture NA1 is decided by the location of the point of the 2nd semiconductor laser emitting light, and an objective lens 75. Therefore, since it can decide in this way, the angle of divergence of a light beam is changed so that a numerical aperture NA2 may be set to 0.6 according to this.

[0023] The spherical lens 50 of triangle prism partial 30a can be operated as a lens for adjusting the basis of such an aim, and the flare angle of a light beam. It means that this can adjust NA (numerical aperture) on an objective lens 75. And it considers as the configuration which has arranged two semiconductor laser and a photodetector on the semi-conductor substrate 10 of 1 again. Furthermore, the advantageous configuration mentioned already of making a package 20 intervening, unifying [ a beam splitter 30 and ], and carrying out seal structuring of this means that the above-mentioned thing is realizable (without it follows and changes the location of the semiconductor laser in this configuration, an arrangement configuration, etc.), with this maintained. Although there is no optical path which goes to the width by the beam splitter 30 again and it turns out that it is that to which occupancy area of optical system is contraction-ized, and there are



also few components mark and it can contain this with one package 20 in what is depended on this example Since there is no optical path by which such an advantage is not lost, either, it also means that considering as the required numerical aperture NA1 and NA2 can be realized, and an optical unit and semiconductor laser go horizontally by the beam splitter, -izing of the occupancy area of optical system can be carried out [ \*\*\*\* ], and NA (numerical aperture) on the objective lens 75 with a lens (here spherical lens 50) can be adjusted, and it is miniaturized. In addition, a silica DORIKARU lens is sufficient as the spherical lens 50 was already described.

[0024] It unites with the beam splitter which arranges two or more semiconductor laser and photodetectors on a semi-conductor substrate and by which the diffraction grating was prepared in the close outgoing radiation side of light. By for example, the thing considered as the structure which reduces the component part as an optical pickup and seals an optical unit if the thing according to above-mentioned this example which can aim at improvement in dependability or endurance and can attain a miniaturization advances one step by making this into the base further, and has the profitableness which can consider the technique of the following contents and it is made such, it is much more effective -- it becomes.

[0025] With the above-mentioned configuration, the spherical lens 50 is selected and provided in the lens (specifically concave lens) which has a predetermined angle of divergence beforehand as what can obtain the angle of divergence of such a light beam on the design so that numerical aperture  $NA_2 = 0.6$  on the objective lens 75 in the case of DVD can be realized in the case of the numerical aperture  $NA_1 = 0.45$  on CD-R and the objective lens 75 at the time of CD. It means that this had extended the focal distance in false.

[0026] One policy which will accept it here besides for making it such is the thing of the technique about the refractive index of the \*\* material (glass material) to be used, therefore it is the optical path of the system which reflects in respect of BS from this point, and results in an objective lens, and the optical path of the system which goes straight on and results at an objective lens, and the correspondence from a viewpoint whether to make \*\* material the same or to make it what different is mentioned.

Moreover, it is good to make an incident angle dependency small from the point of \*\*\*\* which the quantity of light is changed, prevents use effectiveness falling, and raises use effectiveness by whenever [ incident angle ], therefore it is desirable that correspondence from such a viewpoint can be performed.

[0027] [1] Make BS into the \*\* material of high refraction. Like a degree type, the optical optical path length who penetrates \*\* material becomes long.

$$d = d' (1 - (1/n))$$

(n: A changed part of the refractive index of an ingredient, and the d:optical optical path length)

When using SFS1 (Hoya Corp. make) as compared with the case where the common glass ingredient (refractive index 1.52) of BK7 is used here, for example the refractive index n of SFS1 -- for example, the wavelength of 630-650nm --  $n =$  -- since it is about 1.9 (the wavelength of 780nm  $n = 1.89$ ) -- the case of BK7 -- comparing -- the term of  $(1/n)$  in the above-mentioned formula -- small -- becoming -- a result --  $d'$  -- being fixed - - supposing -- d -- large -- becoming . Thus, since it becomes long by the above-mentioned formula, it is good to enlarge n.



[0028] [2] High \*\*\*\*\* material is good to an angle-of-incidence dependency (light beam with P or S polarization property which carries out incidence). For example, it is the above SFS1 ( $n=1.9$ ).

[0029] [3] The above SFS1 ( $n=1.9$ ) of high \*\*\*\*\* material and the other \*\* material of the \*\* material with a concave lens side are the combination (effectiveness; the optical path length can be shortened) of BK7 ( $n=1.52$ ), or its reverse. In the former mode, triangle prism partial 30a is made into the \*\* material of SFS1, and the \*\* material of parallelogram prism partial 30b is set to BK7 here.

[0030] combination voice with the latter reverse on the other hand -- it may set like, parallelogram prism partial 30b may be made into the \*\* material of SFS1, and the \*\* material of triangle prism partial 30a may be set to BK7. If the refractive index of the \*\* material of triangle prism partial 30a is made large and a refractive index will be conversely made small the place which the optical path length can earn, when there will be a merit that a flare angle can be enlarged, therefore it will think this point as important, this reverse mode is adopted and a flare angle can become large by selection of the \*\* material of the glass of a concave lens.

[0031] In above-mentioned this example, although the concave lens is adopted as a spherical lens 50, this can be used also for the thing at the time of considering as a convex lens.

[0032] Moreover, in the example, although the parting line of an applicable diffraction grating or the direction of a parting line of the photodetector for focuses was shown as what was illustrated to drawing 2 -5 to the truck (T), it is not restricted to this. Therefore, the parting line of a diffraction grating or the direction of a parting line of the photodetector for focuses may be 0-45-degree within the limits to a truck.

[0033] Drawing 6 - drawing 8 show other examples (the 2nd example) of this invention. This example is amelioration of the above-mentioned example (the 1st example), and is the compatible optical unit of CD-R and DVD-ROM. About a theoretic configuration and the operation effectiveness, such as share-izing [ of the unit already described about the 1st example ], unification, and seal-ized structure, it can consider as the same thing as the 1st example fundamentally (this point is the same in other examples). Below, the important section of this example is explained.

[0034] As shown in drawing 6, what is depended on this example An outline and semiconductor laser LD1 and LD2, It has the grating component 44 and the hologram component 45 ( drawing 7 ) as a diffraction grating which were prepared in the beam splitter inferior surface of tongue parallel to the semi-conductor substrate 10 which has arranged photodetectors 4 and 5, and these semiconductor laser LD1 and LD2 and photodetectors 4 and 5. While arranging a collimator lens 72 between the beam splitters 30 and objective lenses 75 which carried out the trapezoid configuration Forming a spherical lens 50 between the grating component 44 and the beam splitter side 31, the optical unit has the photodetector 101 for front monitors further again. 1st semiconductor laser LD1 is laser with a wavelength of 780nm (S polarization), and 2nd semiconductor laser LD2 is laser with a wavelength of 630-650nm (P polarization).

[0035] The non-polarized beam splitter sides 31 (BS) are  $T_s$ (S polarization permeability);50% and  $R_s$ (S polarization reflection factor);50% to the wavelength of 780nm of the 1st semiconductor laser, and they are  $T_p$ (P polarization permeability):0-50% and  $R_p$ (P polarization reflection factor);50-100% to the wavelength of 630-650nm

of the 2nd semiconductor laser. There is a grating (the 2nd diffraction grating) in the lower part of a beam splitter 30 between the 1st semiconductor laser (LD1), and the spherical lens 50 is formed between this grating 44 and the beam splitter side 31. In the example of illustration, although it is the mode used as the grating component 44 by joining the sheet metal in which the diffraction grating was made to form as a grating for three beams to beam splitter 30 inferior surface of tongue, it is not restricted to this configuration but mentions later about this point. The photodetector 101 for front monitors which carries out the monitor of the output quantity of light of two semiconductor laser LD1 and LD2 is joined by the vertical plane (side face of triangle prism partial 30a) of the trapezoidal-prism side of a beam splitter 30 further again.

[0036] [Hologram (HOE)] About hologram component 45 grade, it is as follows again. It diffracts according to the condition of P polarization from the account silver medium 80, or S polarization at the time of each record-medium (CD-R or DVD-ROM) use. the field a1 which carries out a vertical angle as shown in drawing 7 although the hologram (HOE) quadrisectioned centering on the optical axis is specifically led to photodetectors 4 and 5, respectively, and a2; -- b1 and b2 -- diffraction differs for every two. Fields a1 and a2 are P polarization diffraction, and fields b1 and b2 are S polarization diffraction. Also when the record medium 80 (CD-R) which corresponds a light beam with a wavelength of 780nm is irradiated in this example Also when a light beam with a wavelength of 630-650nm is irradiated at the corresponding record medium 80 (DVD-ROM) Although an information signal is detectable by carrying out incidence of the reflected light obtained at a case, respectively to this quadrisection hologram component 45, therefore receiving the reflected light from the correspondence record medium 80 with photodetectors 4 and 5 In this case, an information signal is set to two thirds, one third of components are the zero-order diffracted lights, and two thirds of remaining components serve as the primary [ \*\* ] diffracted light. A photodetector, a focus, and tracking detection can use the detection method of a publication etc. for the above-shown reference 3 in more detail (see for example, this reference drawing 4 ).

[0037] [Spherical lens] In this example, 1st semiconductor laser LD1 and 2nd semiconductor laser LD2 are further arranged mutually with the spherical lens 50 in the location [ \*\*\*\* ] to the collimator lens 72 which makes a light beam parallel light. In this way, a spherical lens 50 is arranged between 1st semiconductor laser LD1 and the beam splitter side 31, and 1st semiconductor laser LD1 and 2nd semiconductor laser LD2 are mutually arranged to a collimator lens 72 here in a location [ \*\*\*\* ]. Conditions distance-related [ from each point of each semiconductor laser of arrangement emitting light to the collimator lens 72 concerned ] can be set up on the same semi-conductor substrate 10 by this with this lens 50 that selected the flare angle beforehand. Like a result and the 1st example, NA (numerical aperture) on an objective lens 75 can be adjusted, and the required numerical aperture NA1 (for example, 0.45) mentioned already, respectively and numerical aperture NA2 (0.6) can be realized with the same effectiveness as the case of the 1st example like the drawing 6 illustration.

[0038] Drawing 8 shows the configuration of the photo detector of the applicable photodetectors 4 and 5 etc. the example of the location configurations of the primary [ \*\* ] diffracted light which passed the quadrisection hologram component 45 which illustrated this to drawing 7 , and a photo detector -- it is -- two photodetectors 4 and 5 -- what has each division photo detector 4PD1 located in the both sides of the point (zero-

order diffracted light) emitting [ LD ] light - 4PD3 (trichotomy PD), and 5PD11 - 5PD42 (8 division PD), respectively can be used for each like illustration. A servo signal and an information signal can be acquired by using field partial 5PD11 - 5PD42 as a photodetector for tracking error signal detection fundamentally by using field partial 4PD1 - 4PD3 as the photodetector for focal error signal detection, and calculating the detection output by the diffracted light which carries out incidence to these.

[0039] The time of a white omission pattern irradiating a 630-650nm light beam among drawing here at a record medium 80, Moreover, the time of a black painting pattern irradiating a 780nm light beam at a record medium 80, What expresses the situation of each diffracted light and is shown by signs a11, b11, a21, and b21, and a12, b12, a22 and b22 Respectively, the location configuration of the diffracted light in a before [ a photodetector ] side focus (condition which has a focus in a before [ a photodetector side ] side), and a backside [ a photodetector ] focus (condition which has a focus in the backside of a photodetector side) is illustrated. Furthermore, the detection output in field partial 5PD11, 5PD21, 5PD31, 5PD41, 5PD12, 5PD22, 5PD32, and 5PD42 Supposing it expresses with PD11, PD21, PD31, PD41, PD12, PD22, PD32, and PD42, respectively, in the detection approach by the 3 beam method, the phase contrast method, and the push pull method, the following operations and a method can perform each detection.

[0040] [3 The beam method]

$(PD12+PD42)-(PD11+PD41)$

[Phase contrast method]

$(PD21+PD32)-(PD22+PD31)$

[The push pull method]

$(PD22+PD32)-(PD21+PD31)$

[0041] Data information is acquired with the total output of PD11-PD42 of all fields, and PD1-PD3.

[0042] Therefore, when a light beam with a wavelength of 780nm is irradiated at a record medium 80 (CD-R), incidence of the tracking error signal detection is carried out by three light beams (dl-d3 (spot)) by 3 beam methods at the quadrisection hologram component 45, and the diffracted light becomes six light beams on 2 division photo detector divided in parallel with the direction of a truck (T) of this record medium 80. Moreover, when a light beam with a wavelength of 630-650nm is irradiated at a record medium 80 (DVD-ROM), incidence is carried out to the quadrisection hologram component 45 by one light beam (only dl) by the phase contrast method, and the diffracted light becomes two light beams on 2 division photo detector. In this example, photodetectors 4 and 5 can be carried out as such a configuration.

[0043] [The spherical lens in the prism which carried out the trapezoid configuration and relation of a diffraction grating] In this example, the sheet metal (grating component 41) with which the diffraction grating was formed after forming the spherical lens 50 which consists of the space section in the condition of having etched the glass ingredient (SFS1 or BK7) about the triangle prism part 30 is joined. If a diffraction grating is further formed on the surface of a spherical lens in order to reduce components mark although the same operation effectiveness as the 1st example can be done so even if it follows such a configuration, this sheet metal is unnecessary. Therefore, it is much more effective in a more advantageous thing at this point. Therefore, this invention may be carried out in this way, and may be carried out.



[0044] Furthermore, if it is chosen as what suited the polarization property of the semiconductor laser of short wavelength (630-650nm) (Rs is [ example / P polarization property of a beam splitter ] 90 - 100% at 0 - 10% in P polarization semiconductor laser for Tp) using a non-polarization beam splitter, efficiency for light utilization can improve and improvement in the endurance of the semiconductor laser of short wavelength can be aimed at. This invention may be carried out in this way, and may be carried out.

[0045] Next, drawing 9 explains the example which is an example of further others of this invention (the 3rd example), for example, is an optical unit with record of the magneto-optic disk for light modulation record, or the compatibility of playback and CD-R. What is depended on this example is the optical unit of the structure which has arranged two laser by the semiconductor laser LD1 (wavelength of 780nm), and LD2 (wavelength of 630-650nm) from which wavelength differs to the semi-conductor substrate 10, intervened and sealed the package 20 by the beam splitter 30 by the prism parts 30a, 30b, and 30c.

[0046] This prism part consists of triangle prism partial 30a and two parallelogram prism parts 30b and 30c, and triangle prism partial 30a is a prism part which consists of the quality of the material of BK7, and the quality of the material of SFS1. And the interface of triangle prism partial 30a and parallelogram prism partial 30b is the wavelength selection filter (diode lock mirror side) 32, and the beam splitter side 34 which consists of multilayers is formed in an interface with the parallelogram prism parts 30b and 30c. That is, in this example, the lens part which consists of the quality of the material of BK7 (low refractive index  $n=1.52$ ) formed by carrying out ion etching, for example to the prism of the quality of the material of SFS1 (high refractive index  $n=1.9$ ) is formed as a semi-sphere lens 51 about the spherical lens for adjusting the flare angle of a light beam here. The diffraction grating 46 for three beams is formed in the location of this lens. Like illustration, therefore, between semiconductor laser LD1 and triangle prism partial 30a The lens part 51 which can adjust the flare angle of the light beam by which outgoing radiation is carried out from semiconductor laser LD1 exists. A diffraction grating 46 can be considered as the configuration arranged on such a lens, and is effective in the ability to prevent the optical distortion of the sheet metal by the adhesive strength of triangle prism partial 30a and the diffraction grating 46 (grating side) for 3 beams.

[0047] Moreover, between the prism part and the semi-conductor substrate 10, the analyzer 111 (Wollaston prism) which detects an optical MAG signal, and three photodetectors 6a, 6b, and 7 arranged on the semi-conductor substrate 10 are formed like illustration. At the time of luminescence of semiconductor laser LD2, about the light beam from this semiconductor laser, it can be made to be able to reflect by the inclination end face of parallelogram prism partial 30c, can be made to be able to go to the plane of composition of triangle prism partial 30a and parallelogram prism partial 30b, and can lead to a collimator lens 72. It can be made to be able to reflect in the plane of composition of this prism partial 30b and parallelogram prism partial 30c, and the light beam drawn about the return light of reflex time into parallelogram prism partial 30b from triangle prism partial 30a from the record medium can be led to the above-mentioned analyzer, and can make the above-mentioned photodetector receive light.

[0048] [ when thickness of a prism part is further set to  $h$  like illustration in this example ] Spacing of two semiconductor laser LD1 and LD2, i.e., arrangement spacing on the semi-conductor substrate 10 with a wavelength of 780nm of semiconductor laser LD1



and semiconductor laser LD2 with a wavelength of 630-650nm This is set to 1.5 times as much  $1.5h$  as thickness  $h$  of this prism part (the above-mentioned analyzer 111 will be arranged between this  $1.5h$  tooth space). As for the numerical aperture of a collimator lens 72, image point side range difference is set to  $1.5h$  in the above-mentioned configuration. Then, in order to set  $1.5h$  of these image point side range differences to 0.7-1.0, the above-mentioned semi-sphere lens 51 (or a cylindrical lens is sufficient as the 1st example also described) is used. When it carries out like this, with the semi-sphere lens 51, it is brought close to the point of semiconductor laser LD2 with a wavelength of 630-650nm emitting light (false target), therefore can make with a flat optical unit, and spacing of the prism parts 30a, 30b, and 30c and a collimator lens 72 narrows, and is miniaturized. Also by such configuration, like the 1st example, the operations effectiveness, such as share-izing of a unit, unification, and seal-izing, can be done so, an adjustment setup of NA (numerical aperture) on the objective lens which is not illustrated with a lens 51 is possible, for example,  $NA=0.38-0.45$  and  $NA=0.6$  can be realized, and, moreover, it will become advantageous to flatness and a miniaturization.

[Operation in the case of drawing 9 ] If the operation in the case of drawing 9 etc. is explained, in this drawing, it is reflected in a reflector, and the beam splitter side 34 will be penetrated, it will be reflected in respect of [ 32 ] a dike lock mirror, and the light beam by which the linearly polarized light with a wavelength of 630-650nm (LD2) was emitted will turn into an parallel light beam by the collimator lens 72. And the objective lens which is not illustrated is penetrated and it converges on the recording surface of a magneto-optic-recording medium. The light beam (return light) reflected on the recording surface of a magneto-optic-recording medium penetrates an objective lens and a collimator lens 72 again. The linearly polarized light which reflected in respect of [ 32 ] the dike lock mirror, and reflected in respect of [ 34 ] the beam splitter, and had the component of a car rotation signal penetrates Wollaston prism 111. It separates into three light beams, light is received by three photodetectors 6a, 6b, and 7 on the semi-conductor substrate 10, and the information on the recording surface of a magneto-optic-recording medium can be recorded or reproduced. Record of the light beam by which the linearly polarized light with a wavelength of 780nm (LD1) was emitted, or in playback, it is parallel to the beam splitter side 31 which is not polarized in the beam splitter 30 of the prism in which drawing 6 carried out the trapezoid configuration, and it carries out the operation as said beam splitter side 34 with the same reflector which carries out a boundary the inside of air. And Wollaston prism 111 is penetrated, light is received with a photodetector 7, and the information on the recording surface of a phase change record medium can be recorded or reproduced.

[0049] Drawing 10 explains the example of further others of this invention (the 4th example). This example is suitable for an optical unit with the compatibility of a disk with a transparence substrate thickness [ of MO for optical MAG (for light modulation record) ] of 1.2mm, and a disk with a transparence substrate thickness [ of ASMO (field modulation record) ] of 0.6mm so that the after-mentioned may also be carried out. The semiconductor laser LD1 (wavelength of 780nm), and LD2 (wavelength of 630-650nm) from which an outline and wavelength differ in the thing of the example of illustration as shown in drawing 10 , The semi-conductor substrate 10 which has arranged these semiconductor laser LD1 and LD2 and two photodetectors 8 and 9, The diffraction grating by which opposite arrangement is carried out with each semiconductor laser LD1

and LD2, respectively by the two analyzers 115,116, prism partial 30a and 30b', and inferior-surface-of-tongue side of the beam splitter 30 by 30d (here) It has the diffraction grating 46 for 3 beams and the transparency mold polarizability hologram component 47, and the photodetector 101 for front monitors of semiconductor laser with a wavelength [ of 780nm ], and a wavelength of 630-650nm.

[0050] What is necessary is to use like illustration the spacer 121 of transparency with which the concave lens 120 was formed in the whole surface as an arrangement location of this diffraction grating 46, and just to make it form on this spacer, in using for MD about the diffraction grating 46 for the three above-mentioned beams here. In this example, such structure is adopted, the lens part (concave lens 120) which can adjust the flare angle of the light beam from semiconductor laser LD1 between semiconductor laser LD1 and triangle prism partial 30a exists even in this case in this way, and a diffraction grating 46 can be considered as the configuration arranged on this lens. And the following advantages are brought about by forming a concave lens 120 in an outgoing radiation side, and making it the configuration which forms the diffraction grating 46 for three beams in plane of incidence in this way. That is, the location of the diffraction grating 46 for three beams can be chosen by choosing the thickness of the above-mentioned spacer 121 used. Every time this pulls, it leads to it being easy to double with truck spacing of a record-medium side, therefore can mention such a point as further profitableness with the above-mentioned configuration.

[0051] Hereafter, this order explains further the component on a prism part, two diffraction gratings, and a semi-conductor substrate, relation with a package, etc.

[0052] [Prism] As for the joint with parallelogram prism partial 30b' joined to the triangle prism part 30 and its triangle prism side, the wavelength selection filter 32 is formed. This wavelength selection filter can be considered as 100% reflection of S polarization, 70% transparency of P polarization, and 30% reflection from wavelength 630 to the wavelength of 650nm semiconductor laser LD2, and can be formed to the wavelength of semiconductor laser LD1 with a wavelength of 780nm by the multilayers of 50% transparency of P polarization, and 100% reflection of S polarization.

[0053] Moreover, a 30d [ of trapezoidal-prism parts joined to parallelogram prism partial 30b' and its parallelogram prism side ] joint is the polarizability hologram 33 (for example, reflective mold polarization hologram without a parting line) of a reflective mold. This shall consider as 15% of primary [ \*\* ] P polarization diffracted lights, and 70% of zero-order diffracted lights from wavelength 630 to the wavelength of 650nm semiconductor laser LD2, and makes the primary diffracted light of P polarization 20% to the wavelength of semiconductor laser LD1 with a wavelength of 780nm.

[0054] Moreover, about relation with a diffraction grating, it is as follows. That is, corresponding to each semiconductor laser, there are two diffraction gratings (46 47) in plane of incidence like illustration from the semiconductor laser LD1 and LD2 of two different wavelength. The transparency (for example, trichotomized) mold polarizability hologram 47 (hologram in which a convex lens and the -primary diffracted light had a concave lens operation in the +primary diffracted light) has countered with 650nm semiconductor laser LD2 from wavelength 630, and this is formed in the parallelogram prism partial 30b' inferior surface of tongue. And it is the diffraction grating 46 for three beams that this and another have countered with semiconductor laser LD1 with a wavelength of 780nm. This is formed in the spacer 121 of the given thickness which has

a concave lens 120 and was prepared in the triangle prism partial 30a inferior surface of tongue as already touched. Moreover, the photodetector 101 for front monitors for LD which carries out the monitor of the amount of luminescence of semiconductor laser LD1 and LD2 is directly joined by the side face (vertical plane) of triangle prism partial 30a with the adhesives of an ultraviolet curing mold.

[0055] [The component on a semi-conductor substrate and relation with a package] on the semi-conductor substrate (Si substrate) 10 There are two semiconductor laser LD1 and LD2 and two photodetectors 8 and 9 (for example, two photodetectors carried out 6 \*\*\*\*s). Further on these photodetectors Two analyzers 115,119 (here, although it is a polarization beam splitter (polarizing prism), an optical waveguide device by which the publication was carried out, for example to JP,10-241199,A (reference 5) is sufficient) which inclined 45 degrees to the activity side of semiconductor laser are arranged. When prism is joined by each partial 30a, 30b', and 30d like illustration, to the semi-conductor substrate 10, the dimension enlarges only  $2\delta$  and is set up. In order to prevent oxidization of semiconductor laser LD1 and LD2 or photodetectors 8 and 9, this surrounds the semi-conductor substrate 10 which carried semiconductor laser with a package 20, and when joining and sealing opening by that prism, this \*\*  $\delta$  section depends it on making it become the joint joined with the adhesives of a package 20 upper-limit edge and this prism. When it does in this way, like [ in the case of a thing given in JP,10-334498,A (reference 5) ], without putting in or taking out a concave lens into emission light, therefore a driving gear also becomes unnecessary, as a result an optical pickup is miniaturized more, for example.

[0056] [Function] -- the case where the record medium with which substrate thickness differs is used for below is taken for an example, and the optical unit of the configuration by this example thru/or actuation of an optical pickup, etc. are explained. Here, the case where the disk by ASMO (field modulation record) with a substrate thickness of 0.6mm which was mentioned above, and the 1.2mm disk for light modulation record are inserted shall be described.

[0057] The basis of control of the control section which will not be illustrated based on this if a disk with a substrate thickness of 0.6mm is inserted in equipment, Semiconductor laser LD2 with a wavelength of 630-650nm emits light, and the trichotomized transparency mold polarization hologram 47 (80% transparency) is penetrated. It reflects by the reflective mold polarization hologram 33 (80% reflection) without a parting line, and reflects with the wavelength conversion filter 32 (70% reflection), and by this drawing 10, the collimator lens which is not illustrated is penetrated and it converges on the recording surface of 0.6mm substrate thickness through an objective lens, respectively.

[0058] It reflects in the optical unit of illustration with return and the wavelength conversion filter 32 through these in order of an objective lens and a collimator lens, and the light beam reflected in respect of the record medium is received with two photodetectors 8 and 9 in which carried out incidence to the analyzer (analyzer 115,116 on the other hand) the primary [ \*\* ] diffracted light of whose is one polarizing prism, and polarization separation was carried out in this way by the reflective mold polarization hologram 33 and which were divided into six. In semiconductor laser LD1 with a wavelength of 780nm and coincidence luminescence here, the configuration which carries out the coat of the wavelength selection filter for cutting the wavelength of 780nm



is employable as the plane of incidence of an analyzer. The focal detection in this case is the beam size method, and tracking detection is performed by the push pull method (in this case, a transparency mold polarization hologram component becomes unnecessary). The information on a record-medium side is acquired by each difference signal of two photodetectors 8 and 9.

[0059] Insertion \*\*\*\* and semiconductor laser LD1 with a wavelength of 780nm emit [ the disk of 1.2mm of substrate thickness for light modulation record (light modulation record) ] light. like illustration, the light beam from this semiconductor laser LD1 passes through a concave lens 120, it is made to change, carries out incidence of the flare angle to the wavelength conversion filter 32 here, penetrates this (50% transparency), and draws it in the same direction as the case of the above-mentioned publication in this way -- having -- a result -- a collimator lens and an objective lens -- pass -- it converges on the recording surface of 1.2mm substrate thickness.

[0060] The light beam reflected in respect of the record medium is similarly reflected with return and the wavelength conversion filter 32 in order of the objective lens and a collimator lens, and light is received with two photodetectors 8 and 9 which incidence of the primary [ \*\* ] diffracted light was carried out to the analyzer (another side of an analyzer 115,116) which consists of a polarizing prism of another side, and polarization separation was carried out, and were divided into six by the reflective mold polarization hologram 33. The information on a record-medium side and detection of servo system are the same as that of the time of the disk of 0.6mm substrate thickness by semiconductor laser LD2 luminescence with a wavelength [ of the above-mentioned publication ] of 630-650nm. The diffraction grating 46 for three beams arranged to be related with the lens (for it to be the above-mentioned concave lens 120 in this example) for adjusting the flare angle of a light beam as well as other examples already described also in this case serves as combination by the transparency mold polarization hologram 47, when using the tracking depended on 3 beams. For example, about the case where information is recorded on the recording surface of the optical recording medium (disk) which has 1.2mm guide side of substrate thickness, and had at least two recording surfaces (a spacer is minded and it is multilayer structure) for 0.6mm substrate thickness, as for the photodetector of two 6 division for 780nm in this case, the information on a recording surface is acquired by all total, and servo control of a recording surface and the guide side can be carried out independently. At this time, when performing tracking detection by the 3 beam method, the +primary diffracted light diffracted by the trichotomized transparency mold hologram and this transparency mold hologram can be received with the photodetector carried out 5 \*\*\*\*s. Irradiate a guide truck and a light beam with a wavelength of 780nm is set to a focus or tracking control action. The usual initial actuation (for example, after rotating a disk and making semiconductor laser emit light) after a focal search -- tracking control -- a control truck -- a light beam -- irradiating -- the information on a request behind an on-truck -- reading -- it being able to carry out, and in this case, although the light beam from which two wavelength differs is made to irradiate After irradiating the light beam of semiconductor laser with a wavelength of 780nm first and detecting an on-truck on a guide truck, by making semiconductor laser with a wavelength [ for information record and playback ] of 630-650nm emit light, there is no instability of control and the initial actuation at the time of an initial can be shortened.

[0061] In addition, this invention is not limited to the mode of the above operation. For



example, the additional technique drawn by considering about selection of the refractive index of the \*\* material described in relation to the 1st example etc. can be considered also in other examples, therefore the corresponding written part can be replaced and applied for every configuration also in other examples.

[0062]

[Effect of the Invention] According to this invention, it is possible to be able to carry out [\*\*\*\*]-izing of the occupancy area of optical system, and to be able to adjust the numerical aperture on an objective lens with a lens, and to realize a miniaturization etc. advantageously. moreover, two or more semiconductor laser and photodetectors -- for example, a direct and semi-conductor substrate -- or semiconductor laser -- SABUMA Genipa americana -- minding -- a photodetector -- a metal plate -- it unites with the beam splitter which is arranged good and by which the diffraction grating was prepared in the close outgoing radiation side of light, for example, the component part as an optical pickup is reduced, it can do with the structure which seals an optical unit, and improvement in dependability or endurance can be aimed at.

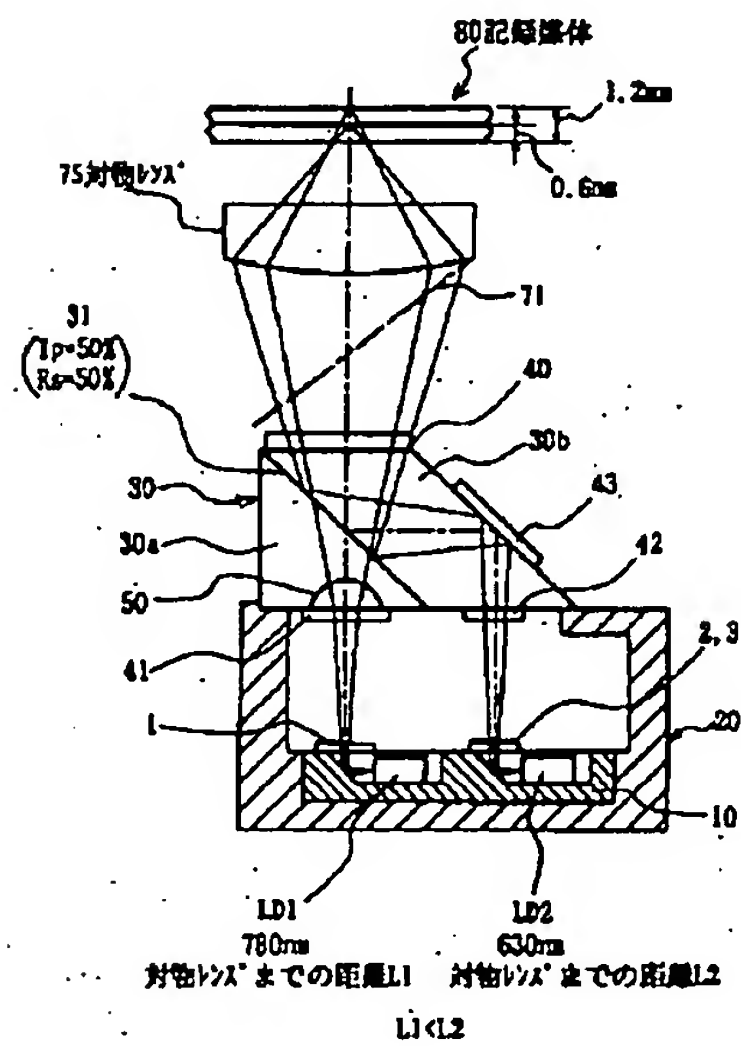
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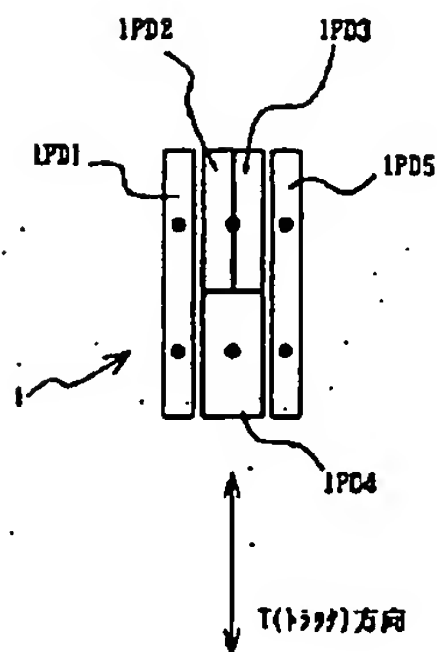
- 46 3ビーム用回折格子  
47 透過型偏光性ホログラム素子 (回折格子)  
50 球面レンズ  
51 半球レンズ  
71 反射ミラー  
72 コリメータレンズ  
75 対物レンズ

- 80 記録媒体  
101 前方モニタ用光検出器  
111 検光子  
115, 116 検光子  
120 凹レンズ  
121 スペーサ  
LD1, LD2 半導体レーザ

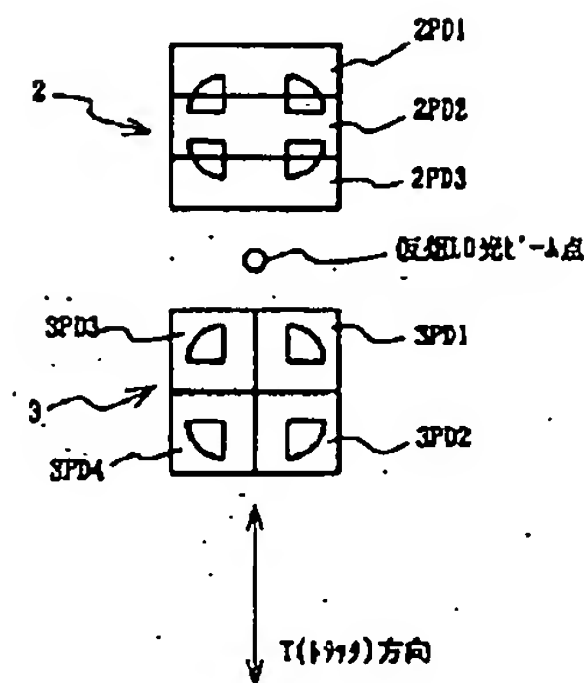
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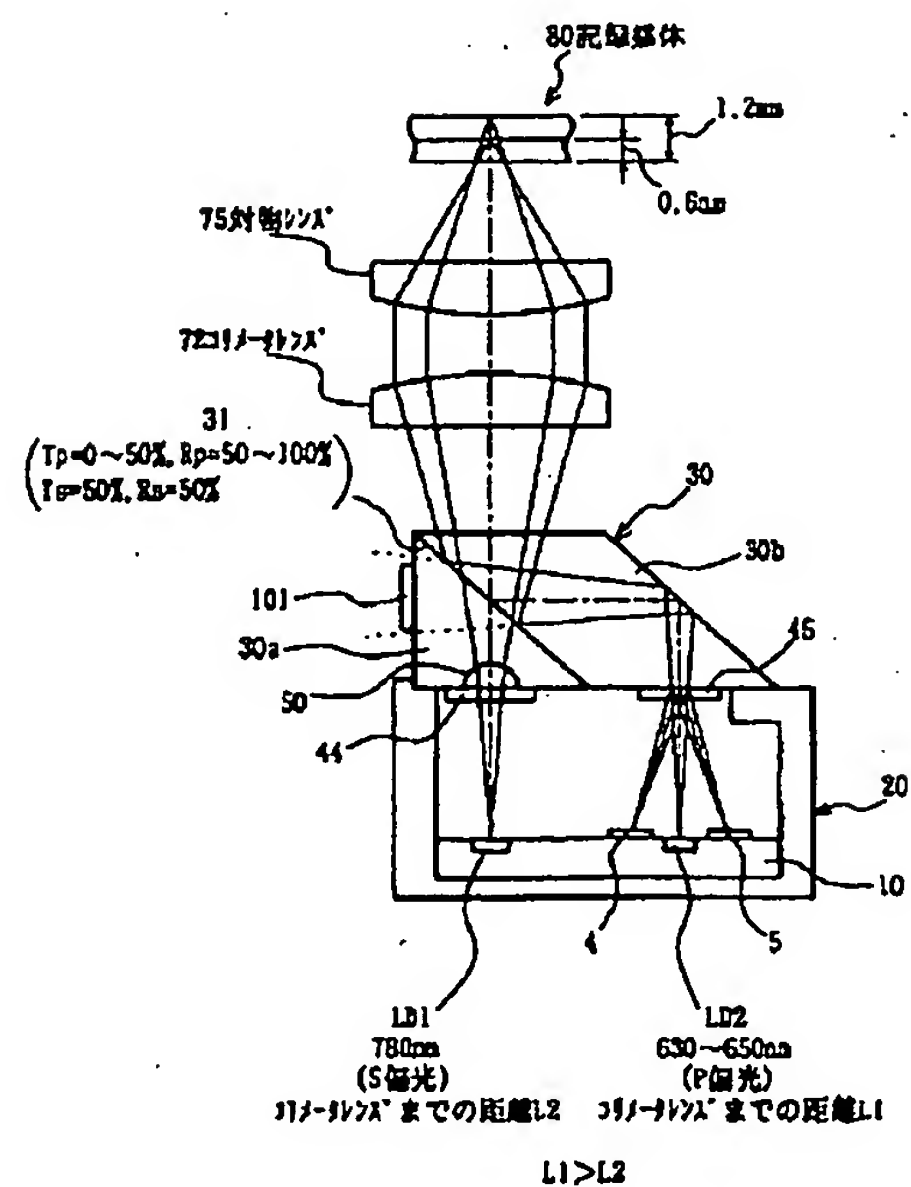
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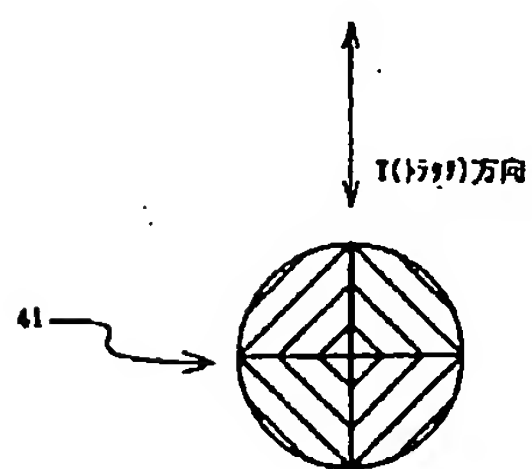
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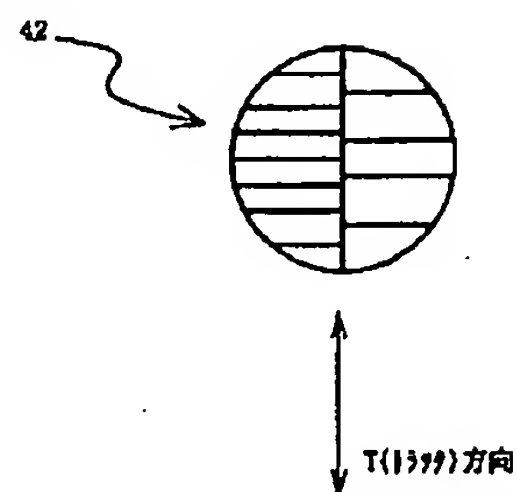
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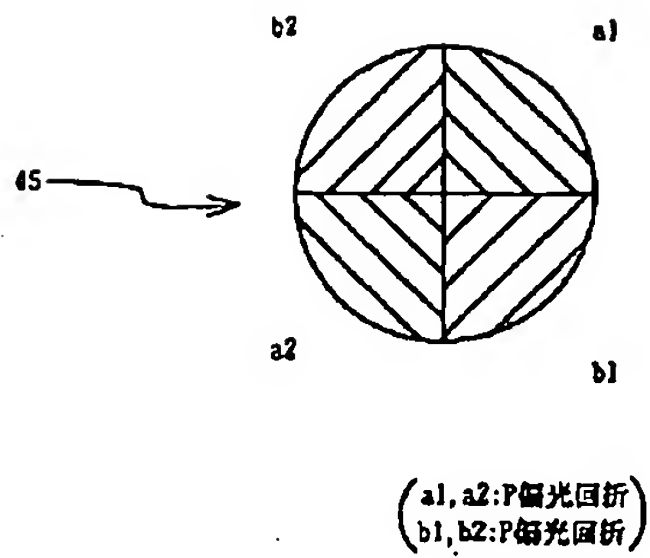
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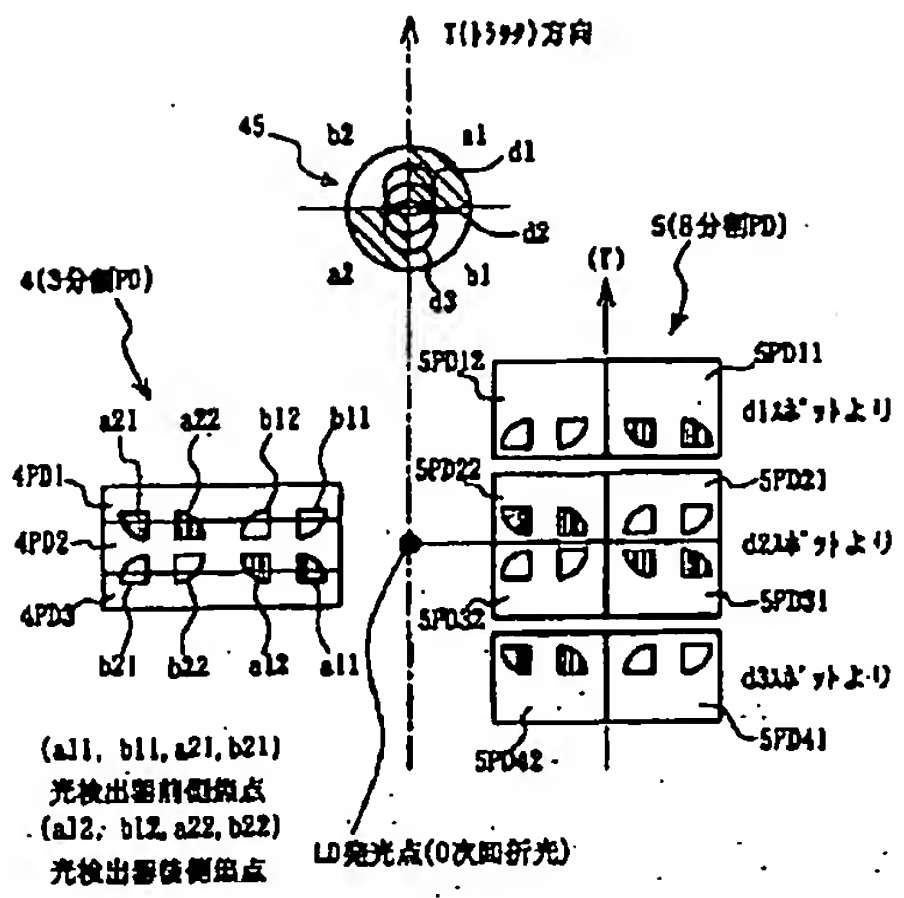
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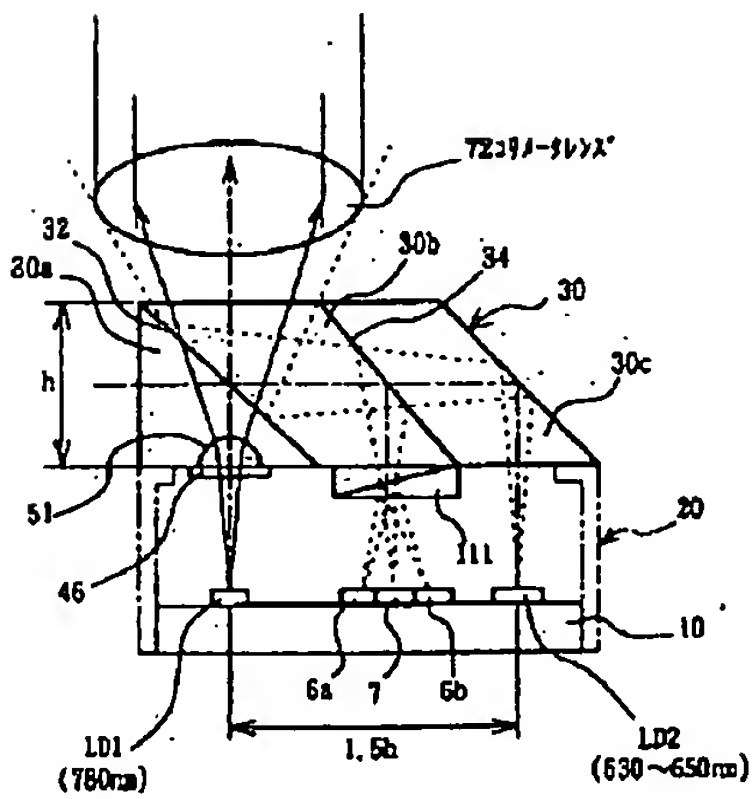
【図7】



【図8】



【図9】



【図10】

